IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Borran, et al.

Title: PARTIALLY COHERENT CONSTELLATIONS FOR MULTIPLE-ANTENNA SYSTEMS

Appl. No.: 10/671,346

Filing Date: 9/24/2003

Examiner: Kevin Michael Burd

Art Unit: 2611

Confirmation Number: 7074

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.132

Sir:

I, Callie M. Bell, hereby declare the following:

1. I am an attorney of record for United States Patent Application No. 10/671,346, filed on September 24, 2003.

2. Attached as Exhibit A is a true and accurate copy of the webpage presented when I selected the link "Journal Articles" using a browser from the webpage http://www.ece.rice.edu/~ashu/ on January 17, 2008. Exhibit A shows a reference to a journal article cited as M. J. Borran, A. Sabharwal and B. Aazhang, On Design Criteria and Construction of Noncoherent Space-time Constellations, IEEE Transactions on Information Theory, pp. 2332–2351, 49(10), October 2003.

3. Attached as Exhibit B is a true and accurate copy of the webpage presented when I selected a link from a webpage created by the Google™ web search engine using a browser on January 17, 2008. The Exhibit B shows the webpage at the uniform resource locator:

http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel5/18/27735/01237124.pdf?arnumber=123712.

Exhibit B shows a reference to an article cited as M. J. Borran, A. Sabharwal and B. Aazhang, On Design Criteria and Construction of Noncoherent Space-time Constellations, IEEE Transactions on Information Theory, pp. 2332–2351, 49(10), October 2003 and a summary of the article.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and believe are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Dated: January 18, 2008

By _____

Callie M. Bell
Attorney for Applicant
Registration No. 54,989

FOLEY & LARDNER
150 East Gilman Street
Madison, Wisconsin 53701-1497
Telephone: (608) 258-4263
Facsimile: (608) 258-4258

Exhibit A

Ashutosh Sabharwal - Microsoft Internet Explorer provided by Foley

File Edit View Favorites Tools Help

Back Search Favorites

Address http://www.ece.rice.edu/~ashu/journal.shtml

Ashutosh Sabharwal
Director, CMC
Assistant Professor, ECE
Chair, ECE Corporate Affiliates

Journals

Book Chapters
Patents
Journal Articles
Conference Papers
Theses
Technical Reports

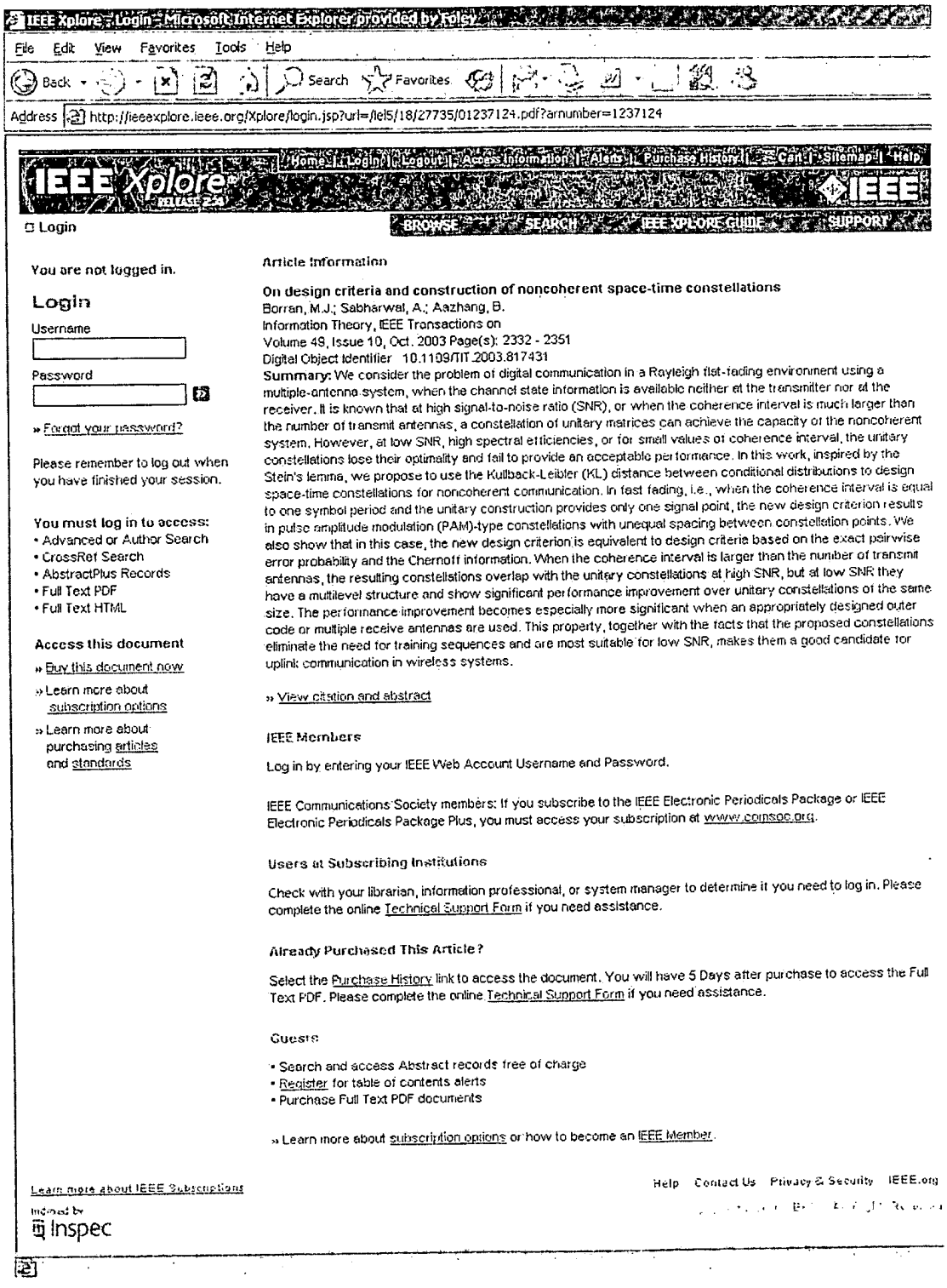
2003-present

- T. Marzetta, A. Sabharwal and B. Aazhang, Antenna Packing in Low-power Systems: Communication Limits and Array Design, to appear in IEEE Transactions on Information Theory, 2008.
- A. Sabharwal and U. Mitra, Bounds and Protocols for a Rate-constrained Relay Channel, IEEE Transactions on Information Theory, July 2007.
- A. Khoshnevis and A. Sabharwal, On the Asymptotic Performance of Multiple Antenna Channels with Quantized Feedback, submitted to IEEE Transactions on Wireless Communications, April 2007.
- C. Steger and A. Sabharwal, Single-input Two-way SIMO Channel: Diversity-Multiplexing Tradeoff with Two-way Training, to appear in IEEE Transactions on Wireless Communications, 2008.
- A. Sabharwal, A. Khoshnevis and E. Knightly, Opportunistic Spectral Usage: Bounds and a Multi-band CSMA/CA Protocol, in ACM Transactions on Networking, 2007.
- A. Chakrabarti, A. de Baynast, A. Sabharwal and B. Aazhang, Low Density Parity Check Codes for the Relay Channel, accepted for publication in IEEE JSAC, Special Issue, 2006.
- N. Ahmed, M. A. Khojastepour, A. Sabharwal and B. Aazhang, Outage Minimization with Limited Feedback for the Fading Relay Channel, IEEE Transactions on Communications, 54(4), pp 659-669, April 2006.
- T. Marzetta, A. Sabharwal and B. Aazhang, Antenna Packing in Low Power Systems: Communication Limits and Array Design, submitted to IEEE Transactions on Information Theory, January 2005.
- A. Chakrabarti, A. Sabharwal and B. Aazhang, Power Optimization in Sensor Networks with a Path-constrained Mobile Observer, revised ACM Transactions on Sensor Networks, September 2005.
- B. Sadeghi, V. Kanodia, A. Sabharwal and E. Knightly, OAR: A Multi-rate Media Access Protocol for Wireless Ad Hoc Networks, ACM/Kluwer Wireless Networks Special Issue on Mobile Computing and Networking, 11(1), pp 39-53, January 2005.
- D. Rajan, A. Sabharwal and B. Aazhang, Delay Bounded Packet Scheduling of Bursty Sources over Wireless Channels, IEEE Transactions on Information Theory, no. 125-144, 50(1), January 2004.
- K. T. Mukkavilli, A. Sabharwal, E. Erkip and B. Aazhang, On Beamforming with Finite Rate Feedback Multiple Antenna Systems, IEEE Transactions on Information Theory, no. 2562-2579, 49(10), October 2003.
- M. J. Borran, A. Sabharwal and B. Aazhang, On Design Criteria and Construction of Noncoherent Space-time Constellations, IEEE Transactions on Information Theory, pp. 2332-2351, 49(10), October 2003.
- B. Aazhang and A. Sabharwal, Algorithms for High Data Wireless Communications: A Power-efficiency Perspective, Wireless Personal Communications, pp. 217-226, Dec 2002.

Pre-2003

- V. Kanodia, C. Li, A. Sabharwal, B. Sadeghi, and E. Knightly, Distributed Priority Scheduling and

Exhibit B



IEEE Xplore - Login - Microsoft Internet Explorer provided by Foley

File Edit View Favorites Tools Help

Back Search Favorites

Address http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel5/18/27735/01237124.pdf?arnumber=1237124

IEEE Xplore RELEASE 2.4

Home | Login | Logout | Access Information | Alerts | Purchase History | Cart | Sitemap | Help

IEEE

BROWSE SEARCH IEEE XPLORE GUIDE SUPPORT

Login

You are not logged in.

Login

Username

Password

» Forgot your password?

Please remember to log out when you have finished your session.

You must log in to access:
- Advanced or Author Search
- CrossRef Search
- AbstractPlus Records
- Full Text PDF
- Full Text HTML

Access this document

» Buy this document now

» Learn more about subscription options

» Learn more about purchasing articles and standards

Article Information

On design criteria and construction of noncoherent space-time constellations
Borran, M.J.; Sabharwal, A.; Aazhang, B.
Information Theory, IEEE Transactions on
Volume 49, Issue 10, Oct. 2003 Page(s): 2332 - 2351
Digital Object Identifier 10.1109/TIT.2003.817431
Summary: We consider the problem of digital communication in a Rayleigh flat-fading environment using a multiple-antenna system, when the channel state information is available neither at the transmitter nor at the receiver. It is known that at high signal-to-noise ratio (SNR), or when the coherence interval is much larger than the number of transmit antennas, a constellation of unitary matrices can achieve the capacity of the noncoherent system. However, at low SNR, high spectral efficiencies, or for small values of coherence interval, the unitary constellations lose their optimality and fail to provide an acceptable performance. In this work, inspired by the Stein's lemma, we propose to use the Kullback-Leibler (KL) distance between conditional distributions to design space-time constellations for noncoherent communication. In fast fading, i.e., when the coherence interval is equal to one symbol period and the unitary construction provides only one signal point, the new design criterion results in pulse amplitude modulation (PAM)-type constellations with unequal spacing between constellation points. We also show that in this case, the new design criterion is equivalent to design criteria based on the exact pairwise error probability and the Chernoff information. When the coherence interval is larger than the number of transmit antennas, the resulting constellations overlap with the unitary constellations at high SNR, but at low SNR they have a multilevel structure and show significant performance improvement over unitary constellations of the same size. The performance improvement becomes especially more significant when an appropriately designed outer code or multiple receive antennas are used. This property, together with the facts that the proposed constellations eliminate the need for training sequences and are most suitable for low SNR, makes them a good candidate for uplink communication in wireless systems.

» View citation and abstract

IEEE Members

Log in by entering your IEEE Web Account Username and Password.

IEEE Communications Society members: If you subscribe to the IEEE Electronic Periodicals Package or IEEE Electronic Periodicals Package Plus, you must access your subscription at www.comsoc.org.

Users at Subscribing Institutions

Check with your librarian, information professional, or system manager to determine if you need to log in. Please complete the online Technical Support Form if you need assistance.

Already Purchased This Article?

Select the Purchase History link to access the document. You will have 5 Days after purchase to access the Full Text PDF. Please complete the online Technical Support Form if you need assistance.

Guests

- Search and access Abstract records free of charge
- Register for table of contents alerts
- Purchase Full Text PDF documents

» Learn more about subscription options or how to become an IEEE Member.

Learn more about IEEE Subscriptions

Indexed by Inspec

Help Contact Us Privacy & Security IEEE.org